

## Evaluation of Fiscal Effort in Developing Countries : The Case of Morocco

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### Abstract

In recent years, Moroccan economic growth has accelerated relatively, but tax revenues have remained relatively stable (averaging 20% of GDP). The underutilization of revenues compared to this increasing trend stems from both the structure of the economy and the fiscal policy of the country. The predominance of the agricultural sector and the weight of the informal sector in the economy are factors that do not encourage the mobilization of tax revenues in Morocco. Several institutional and structural factors contribute to an increasing underutilization of tax sources in Morocco. These factors include: (i) the complexity of tax codes; (ii) the intensive use of tax expenditures, reducing the tax base; and (iii) insufficient integration of the informal economy into the tax system. This study aims to assess the fiscal effort in Morocco to evaluate to what extent it is compatible with the country's tax capacity and to explore ways to increase these public resources.

**Keywords :** Fiscal effort, SFA model, Budgetary policy

**JEL classification :** F31, F41, E58, E62, E63.

### Introduction

Taxation is the primary source of funding for the state and also the essential instrument of economic and social policy in developing countries. Reducing poverty and providing public services are the main objectives of strengthening the state's capacity, its accountability, and its ability to meet the expectations of citizens. Taxation also creates conditions for economic growth through the coverage of public expenditures and ensuring wealth redistribution to maintain social peace and promote human development. Taxation is a powerful tool available to public authorities, especially in developing countries, to steer economic policy towards achieving growth and economic and social progress. The economic role of taxation is manifested in its function as a tool for regulating the economy. According to economic theory, taxation has a significant influence on economic growth, employment, savings, investment, capital formation, and other key economic indicators. Marginal tax rates impact economic decisions, including the allocation of time between work and leisure, as well as the choice to seek employment or start a new business, save, and invest. High marginal tax rates can discourage individuals from working more or starting a business; they can also discourage businesses from investing or increasing their investments. Indeed, numerous studies have shown that high marginal tax rates hinder economic growth and impede business activities and investment. From a Keynesian perspective, taxation is always linked to state interventionism. While classical economists long advocated for a repellent role of taxation, the advent of the 1929 crisis allowed Keynesianism to paint a very different picture of what fiscal policy can achieve. Thus, the role of taxation as a means to stimulate economic growth became prominent. Indeed, although theoretical consensus may not be entirely clear, taxation today stands as a significant instrument at the disposal of economic policymakers, impacting the choices of economic agents through multiple channels.

In this context, the interest in this issue has seen countless developments, with the most obvious conclusion calling for cautious handling of this instrument of economic policy. While finding theoretical consensus may prove challenging, the international financial crisis that occurred towards the end of the two-thousands evolved into an economic crisis with significant effects on growth potential both internationally and nationally. It brought discussions about the role of taxation back to the forefront, particularly in light of the degradation of budgetary margins in several countries alongside a significant need to inject new dynamics into insufficient growth. Therefore, the fiscal performance of a country is an important issue to consider, both in developed economies and in developing ones.

That is why tax reforms have been undertaken by many countries, especially developing ones, over the past decade to strengthen tax revenues. In Morocco, the pursuit of tax systems adequate for economic and social structures is a concern to meet competitiveness and economic development goals. Tax revenues are the main component of collected revenues, amounting to 27% of GDP in 2019. These tax revenues contribute to the proper functioning of the state and the reinforcement of its social contract with citizens, as the tax reforms initiated since 1999 continue to seek efficiency and effectiveness for inclusive growth.

The current Moroccan tax system has undergone several reforms since the mid-1980s. The primary objective of these reforms was to develop an efficient and more universalistic tax system. Indeed, Morocco embarked on a vast project of opening up to the outside world, fueled by the gradual dismantling of customs barriers following the signing of free trade agreements with numerous countries or significant economic zones. Today, with customs duties significantly reduced, direct and indirect taxes constitute the bulk of the revenues supporting the state budget. During this period, the tax system has seen the introduction of:

- Value Added Tax (VAT) in 1986;
- Corporate Income Tax (CIT) in 1988;
- General Income Tax (GIT) in 1990, renamed as Income Tax since 2006.

The first national tax conference in Morocco was held in 1999, which led to deliberations on mechanisms for simplifying, enhancing efficiency, and harmonizing the tax system. Since then, several measures have been introduced through finance laws between 2000 and 2010 (such as upgrading tax legislation in 1999-2003, VAT reform in 2005, publication of the general tax code in 2007, CIT reform in 2008, and IR reform in 2010, etc.). These adjustments have allowed Morocco to establish a tax system with the characteristics of modern taxation but without fully achieving the assigned objectives of social equity and economic efficiency.

Analyzing the tax system involves a better understanding of its structures and identifying the various taxes that represent the pillars of the system in terms of revenue. According to data from the Ministry of Economy and Finance in 2019, VAT alone accounted for 36% of tax revenues, followed by CIT with 20% and IR with 17%. These three combined taxes represent 73% of total tax revenues.

Given the importance of this triptych, we will largely focus our analysis on it to evaluate Moroccan fiscal effort. Our aim is to shed light on the optimal balance to achieve for tax revenues on one hand, and to determine the variables influencing this fiscal effort on the other hand, in order to optimize the fiscal variable and enable it to fully play its assigned role.

The analysis of observed tax revenues is not entirely satisfactory, as a significant portion of these revenues depends on structural factors over which economic policy (fiscal policy and other components of economic policy) cannot act in the short term, while the residual portion (fiscal effort) is determined by factors largely dependent on economic policy. In other words, assessing to what extent additional revenues can be generated requires answering the following question: How do actual tax revenues in Morocco compare to its potential level determined by structural factors, i.e., in relation to the country's tax capacity?

This study aims to evaluate the fiscal effort in Morocco in order to assess to what extent it is compatible with the country's tax capacity and to explore ways to increase these public resources.

In other words, we aim to provide answers to the following question: Can the Moroccan government increase its current level of taxation? To address this question and operationalize our research objective, a methodological approach has been adopted to measure fiscal effort in Morocco. It is structured into four parts: firstly, shedding light on the evolution of Moroccan taxation through the study of its stylized facts, including its components and trends at the national level, as well as benchmarking to assess these variables in the international context. Secondly, this work seeks to discuss the role of taxation in the economy through a review of theoretical and empirical literature on the subject. Thirdly, we will discuss the specification of the stochastic frontier efficiency model and the

selection of explanatory variables that will characterize the model. Finally, we will present the analysis of the results and the insights drawn from the study.

The following section is devoted to examining descriptive statistics of the Moroccan economy. Such an exercise should enhance understanding of the factors influencing fiscal potential in Morocco. This naturally involves a historical overview of key variables and policies implemented by public authorities, aimed particularly at improving the level of tax revenue collection. Moreover, an assessment of Moroccan fiscal performance in comparison with results from comparable economies is an important prerequisite for measuring fiscal potential.

In a more detailed manner, the first chapter will be devoted to discussing the stylized facts of the Moroccan economy through the analysis of the evolution of macroeconomic variables, particularly those that have a direct relationship with our subject, namely ordinary revenues and their disaggregated structure, elasticity, concentration, and coverage of public expenditures by these revenues. This analysis will allow us to contextualize our subject within the Moroccan context.

In the second chapter, we will discuss the theoretical and empirical literature on the subject with a comprehensive review of the methods used to assess fiscal effort, as well as the divergences and convergences of studies on the topic. Lastly, in this chapter, we will present the variables used in estimating fiscal effort and their data sources.

The final chapter will analyze the results of estimations from various models to ultimately examine the evolution of Moroccan fiscal effort, in order to draw conclusions aimed at improving Moroccan tax revenues.

### **Chapter 1 : Taxation in Morocco: Analysis and Quantitative Examination**

In Morocco, the tax system has undergone several reforms since the mid-1980s. The main objective of these reforms was to develop a modern tax system that is suitable for the economic and social evolution. These reforms have focused on the main categories of taxes and duties, leading to the implementation of the Value Added Tax (VAT) in 1986 to replace the tax on products and services, the introduction of Corporate Income Tax (CIT) in 1988, and the establishment of the General Income Tax (GIT) in 1990, replacing various scheduled taxes and the complementary contribution. From 1980 to 2015, ordinary revenue in Morocco experienced an upward trend with a slight decrease in 2009 due to the effects of the global economic crisis. Tax revenues constituted the largest share of these revenues, followed by non-tax revenues, which can be attributed, among other factors, to the positive effects of economic activity dynamics and tax reform.

Moroccan taxation has remained a field of perpetual reform. With each budget law, new measures are introduced either to stimulate economic activity or to address specific concerns of certain economic sectors or social categories. In other words, this tax system is used as an economic lever for incentivizing investment in general (such as the Investment Charter of 1995) or in specific sectors, such as affordable housing or offshoring. Additionally, certain sectors benefit from reduced taxation rates (VAT or CIT) or are exempted altogether (agriculture). This raises questions about the overall cost-effectiveness of these tax expenditures and the potential displacement effect they may have by favoring one productive sector over others.

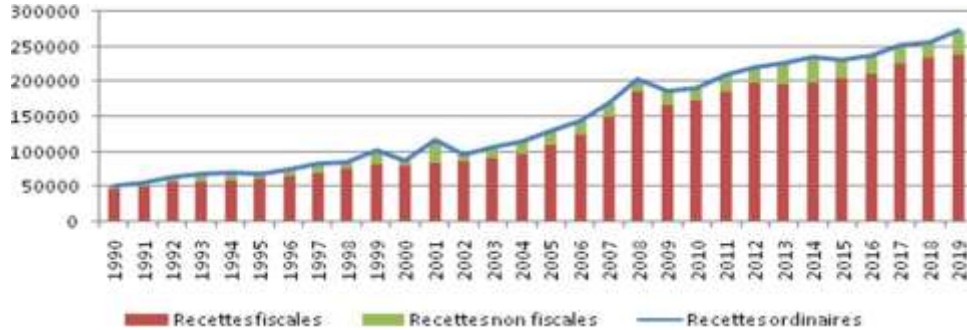
#### **Ordinary revenues**

The analysis of the evolution of ordinary revenues reveals an upward trend, reaching a value of 272476.51 by the end of 2019, representing an average annual increase of 6.2% during the period (1990-2000). This is in contrast to a value of 8% for the second decade (2000-2010) and a value of 4.4% during the last decade (2010-2019). This deceleration during the last decade is attributed to the variation in donations from the Gulf Cooperation Council (GCC) countries.

During the studied period, the evolution of ordinary revenues is reinforced by a similar trend in tax revenues, with an average annual contribution of 88% during the studied period, followed by an average annual contribution of 12% for non-tax revenues. These two components recorded respective

values of 5.8% and 18% in terms of average annual growth for the period (1990-2000); 8.3% and 35% for the period (2001-2010); and 4.4% and 14% for the last decade. Generally, the performances achieved by these revenues can be explained, among other factors, by the positive effects of economic activity dynamics and the fiscal reform implemented during the studied period.

Figure 1.1: Evolution of ordinary revenues and its components



Source: Graph created by us, data source: Ministry of Economy and Finance (MEF)

Table 1.1: Structure of ordinary revenues in %

	1990-2019	1990-1999	2000-2009	2010-2019
Tax revenue	87,7	87,6	87,1	88,8
Non-tax revenue	12,1	12,3	12,1	11,1

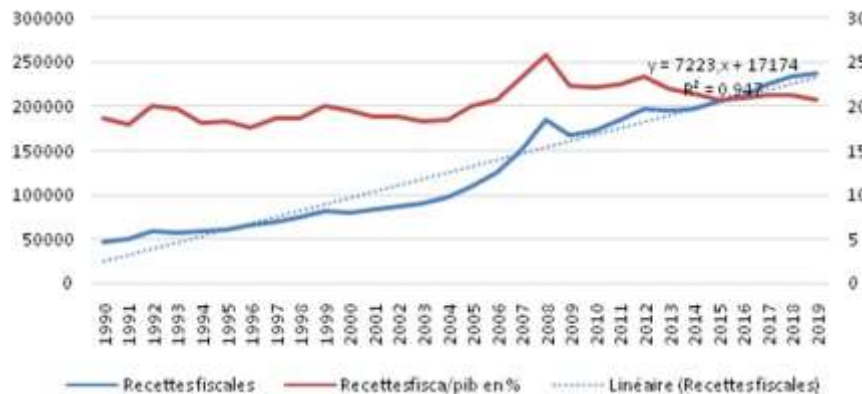
Source: Graph created by us, data source: Ministry of Economy and Finance (MEF)

The evolution of the contribution of tax and non-tax revenues in the composition of ordinary revenues highlights the predominance of tax revenue contribution, averaging 88% in the composition of ordinary revenues. On the other hand, the contribution of non-tax revenues stands at around 12% for the same period, emphasizing the role of economic activity in forming this percentage. In other words, this result appears more natural as it is based on economic activity, highlighting the role of taxation as a robust means to provide substantial and sustainable resources.

**Tax revenues**

With an average growth of 6% between 1990 and 2019, tax revenues increased fivefold between the two periods, reaching 238.24 billion dirhams in 2019. Over this same period, the evolution of tax revenues showed a generally upward trend, with a positive linear slope over the period. Expressed as a percentage of GDP, tax revenues show a generally upward trend with an average value of 20% during the studied period, with the slope tending to become more pronounced for the second decade compared to that recorded for the period (2010-2019).

Figure 1.2: Evolution of tax revenues in Morocco



Source : Graph created by us, data source: Ministry of Economy and Finance (MEF)

**The structure of tax revenues**

The structure of the tax system appears to have evolved significantly. In reality, the structural changes that characterized Moroccan taxation in the late eighties, notably with the introduction of the value-added tax in 1986, the corporate tax in 1988, and the income tax in 1990, have led to a modification of the tax base.

The structure of tax revenues reveals a distribution of contributions from taxes, both direct and indirect, customs duties, and registrations and stamps. During the studied period (1990-2019), these revenues recorded respective average annual contributions amounting to 35%, 45%, 11%, and 6%. This shows the importance of the weight of the first two categories, namely direct and indirect taxes. Direct taxes recorded contributions of 28% and 42% respectively in terms of average annual contribution during the period (1990-2000) before trending upward to reach values of 39% and 49% for the period (2010-2019). This increase came at the expense of a decrease in growth for revenues related to customs duties, which recorded a value of 19% during the period (1990-2000) before reaching 4.5% for the period (2010-2019).

**Figure 1.3: Evolution of the structure of tax revenues**



**Source: Graph created by us, data source: Ministry of Economy and Finance (MEF)**

Regarding registrations and stamps, they showed a significant improvement during both periods, recording respective values of 4.8% and 6.7%. This improvement can be attributed to the performances achieved by the various components of direct and indirect taxes, namely those generated by corporate income tax (CIT), value-added tax (VAT), and individual income tax (IIT). In addition to the robust economic activity, the performance in terms of CIT partly stems from the tax rate reform reduced to 30% (37% for the financial sector), accompanied by the broadening of the tax base through the elimination of deductions on capital gains from the sale of fixed assets and regulated provisions (investment provision, provision for mineral deposit replenishment, and provision for employee housing).

**Direct taxes**

With an average growth of 7% between 1990 and 2019, direct taxes multiplied sevenfold between the two periods, reaching 95.763 billion dirhams in 2019. Over this same period, their evolution showed a generally upward trend, with a positive linear slope over the period.

**Figure 1.4: Evolution of the structure of direct taxes**

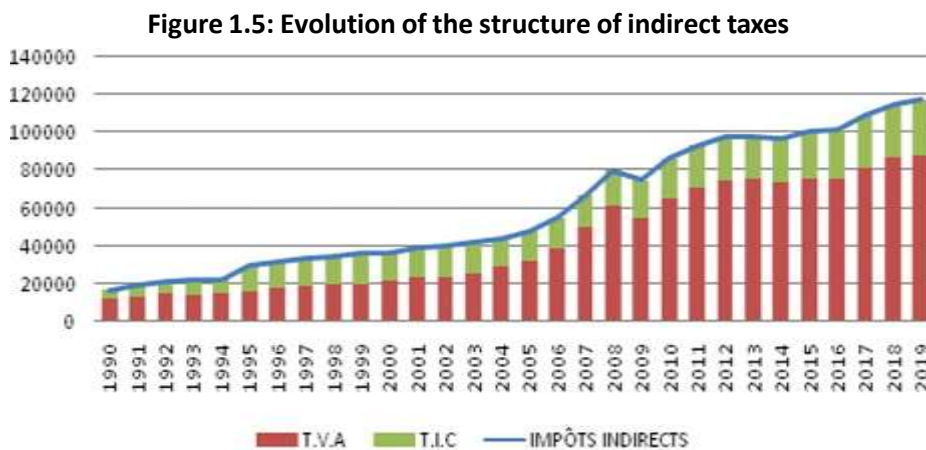


**Source : Graph created by us, data source : Ministry of Economy and Finance (MEF)**

The analysis of the evolution of the structure of direct taxes reveals an identical contribution during the studied period (1990-2019) from the two main categories of these direct taxes, namely corporate income tax (IS) and individual income tax (IR), which amount to 45.2% and 44.7% respectively. Other direct taxes have shown stable evolution with an average of 1.618 billion, resulting in an average annual contribution of 3.7%. The growth rate of these two main categories (IS and IR) varies during the three decades studied. They recorded 2% and 7% respectively in terms of average annual growth during the first decade (1990-2000) before experiencing acceleration for IS and deceleration for IR during the second decade (2000-2010), with values of 3.8% and 0.2% respectively in terms of average annual growth. During the last decade (2010-2019), the growth rates of these two variables reversed. IS experienced a deceleration of 4 points while the behavior of IR increased by one point. For other direct taxes, their behaviors remained stable during the three decades.

### Indirect taxes

During the studied period (1990-2019), indirect taxes showed an upward trend, reaching a value of 117.59 billion in 2019. This value multiplied sevenfold between the beginning and the end of the period. In terms of average annual contribution, revenues related to VAT accounted for an average of 68%, while those related to excise taxes (TIC2) recorded only 31%.



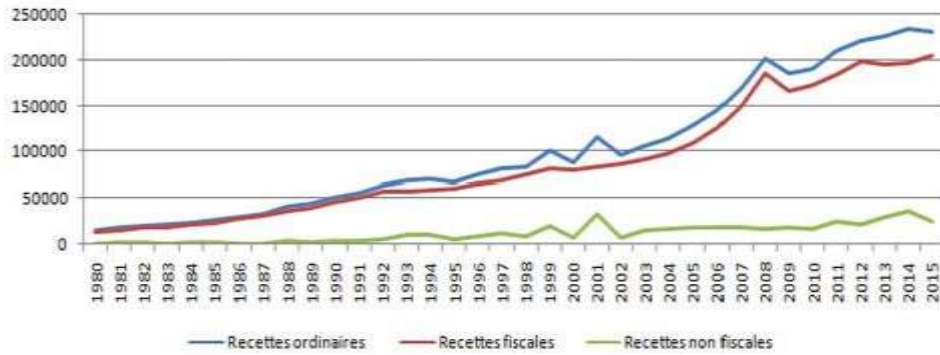
Source: Graph created by us, data source: Ministry of Economy and Finance (MEF)

Indeed, despite the increase in indirect taxes observed since the reform, they remain below the growth recorded by direct taxes. Introduced in 1986, VAT revenues saw a sharp increase between 1986-1992, averaging 12.6% annually, before decreasing to 6.8% between 1993-2019. As for excise tax (TIC) revenues, they are levied at 60% on petroleum products and 35% on tobacco. Their evolution is similar to that of VAT revenues; they experienced a significant increase between 1980-1992, averaging 12.6% annually, before decreasing to 7.4% between 1993-2019.

### Customs duties

Like other emerging and developing countries, Morocco has been engaged in a process of liberalizing its economy since the early 1980s. The opening up has been initiated gradually and has simultaneously led to the implementation of customs tariff reforms, aiming to prepare the national economy to meet the challenge of this strategic choice. Customs duties have seen a remarkable decrease, dropping from 21% of tax revenues in 1990 to 4% in 2019. This decline can be attributed to the effects of tariff reductions undertaken within the framework of free trade agreements concluded with various countries, notably the European Union, Arab countries, Turkey, and the United States. Additionally, Morocco's accession to the World Trade Organization (WTO) has played a significant role.

Figure 1.6: Evolution of customs duties



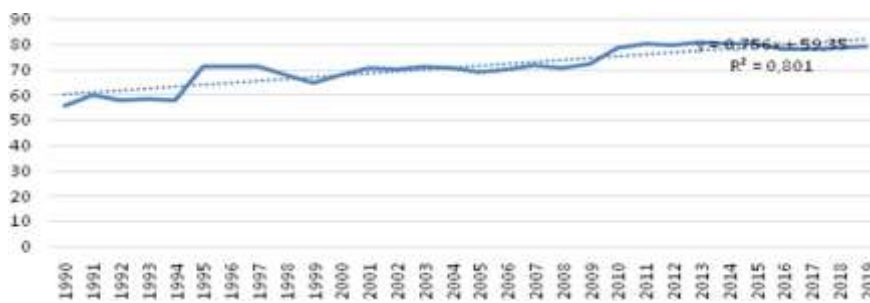
Source : Graph created by us, data source : Ministry of Economy and Finance (MEF)

**The degree of concentration of tax revenues**

The concentration ratio of tax revenues corresponds to the size of a certain number of taxes compared to the overall size of tax revenues. It is used to calculate the degree of dominance of one or more taxes, notably to identify the possibility of a dominant position. The most commonly used method is the Herfindahl-Hirschman Index (HHI), which measures market concentration by summing the squares of tax shares (usually multiplied by 100) of tax revenues. The calculation of the Herfindahl-Hirschman Index, which identifies the distribution of the tax burden across different taxes, is done by summing the squared shares of each tax (multiplied by 100). The higher the HHI of tax revenues, the more concentrated the tax burden is among a small number of tax forms. Generally, as the HHI increases, it indicates an increase in the degree of concentration of the phenomenon being studied. In this regard, particular interest is given to the evolution of the HHI of tax revenues (individual income tax, corporate income tax, value-added tax, excise taxes, customs duties, registration and stamp duties, and other direct taxes) over the period 1990-2019.

The analysis of the evolution of the degree of concentration of these main categories of taxes composing tax revenues in Morocco shows an increasing trend with a positive linear slope of 0.75 over the studied period (1990-2019). According to the conditions of the HHI index, it indicates a strong concentration of tax revenues based on the taxes studied. The HHI increased from 63% during the first decade to 80% during the last decade, with an average annual growth rate of 1.3% during the studied period.

Figure 1.7: Herfindahl-Hirschman Index of tax revenues between 1990 and 2019



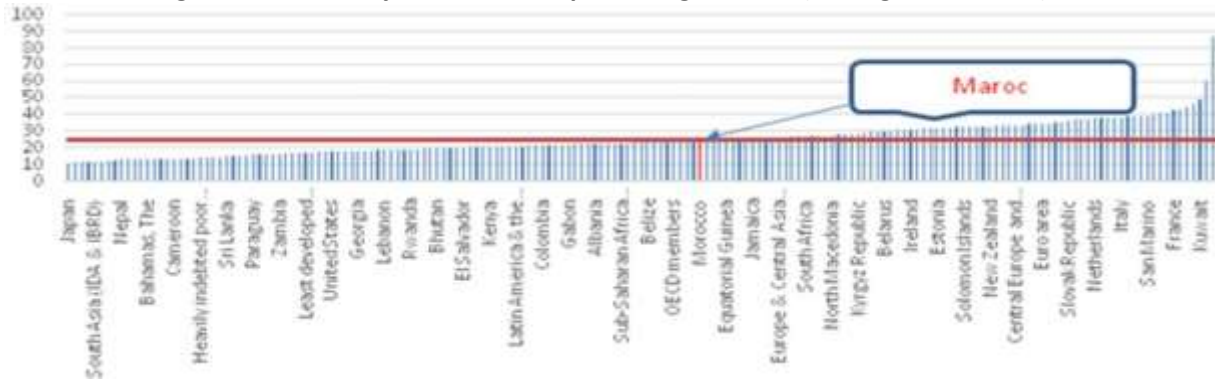
Source : Graph created by us, data source : Ministry of Economy and Finance (MEF)

**Taxation : an international benchmark**

Expressed as a percentage of GDP, ordinary revenues in Morocco are generally lower than the global average recorded over the period from 1993 to 2019. Indeed, with an average value of 24% of GDP over the period examined, ordinary revenues in Morocco are significantly lower than the global average of 29.8% of GDP. However, they remain higher than the average of the group of countries with intermediate income, which stands at 19%.

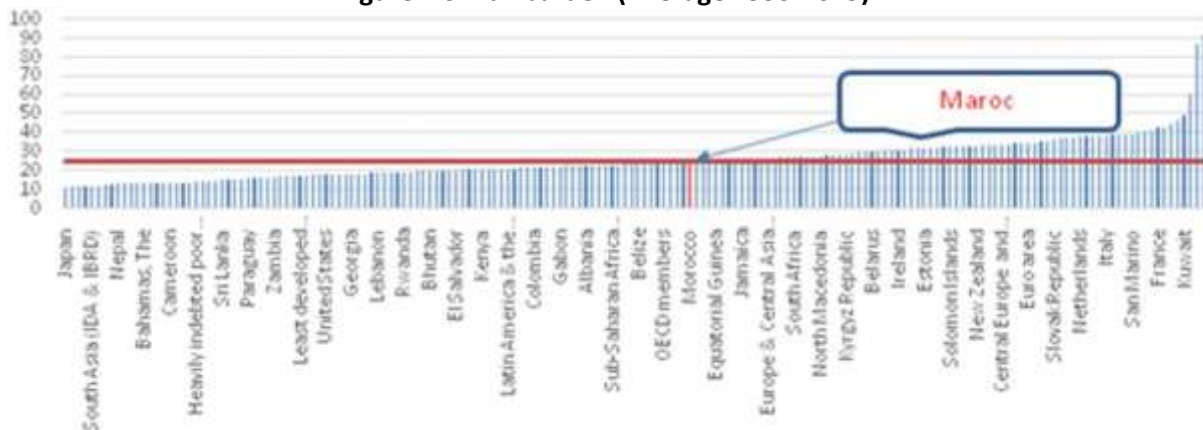
These results change significantly when comparing the data related to tax burden (as shown in the following graph), expressed by tax revenues as a percentage of GDP, over the same period of analysis. Indeed, while ordinary revenues are, on average, lower as a proportion of GDP compared to the global average between 1993 and 2019, the tax burden, on the other hand, appears to be, on average, higher than the global average. This observation highlights the actual weight of taxation in Morocco, especially in terms of its degree of concentration.

Figure 1.8: Ordinary revenues as a percentage of GDP (average 1993-2019)



Source : Graph created by us, data source : Ministry of Economy and Finance (MEF)

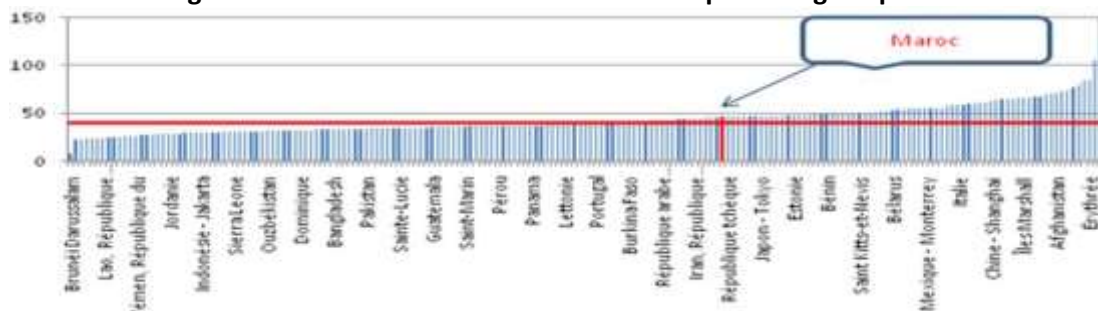
Figure 1.9: Tax burden (Average 1993-2019)



Source : Graph created by us, data source : Ministry of Economy and Finance (MEF)

Another indicator used to quantify the weight of taxation in the Moroccan economy is the Doing Business (DB) ranking. This includes, among other things, corporate income tax, social security contributions and employer payroll taxes, property tax, transfer duties, dividend tax, capital gains tax, financial transaction tax, waste collection tax, motor vehicle taxes, road taxes, as well as minor taxes, levies, or fees, and even value-added taxes when they are not recoverable.

Figure 1.10: Total tax rate on businesses as a percentage of profit



Source : Graph created by us, data source: Ministry of Economy and Finance (MEF)

The indicator chosen to quantify this burden is the total tax rate, which assesses the amount of taxes, duties, and mandatory contributions that a business must pay during its second year of operation, expressed as a percentage of its profits. It appears that the cost of all taxes and duties borne by a medium-sized Moroccan enterprise amounted to 45.8% in 2020 (DB2018), which is generally higher than the global average of 43.7%.

**The tax burden**

The effectiveness of the tax system is measured by its ability to generate sufficient resources to cover state expenditures and contribute to economic growth, at least to the extent of reducing budget deficits and consequently reducing dependence on borrowing resources that lead to macroeconomic imbalances. Tax burden is undoubtedly one of the most controversial concepts in theoretical and empirical debates among public finance specialists and more broadly in financial economics. Commonly expressed as the ratio of tax revenues to gross domestic product, this indicator provides a context and mechanism for directing the allocation of resources in an economy, particularly through tax incentives, and for altering the redistribution of income and wealth. The budgetary and fiscal policy of a state determines the rate and base of different taxes and the tax burden applicable to different economic actors.

**Figure 1.11: Tax burden in Morocco**



**Source: Graph created by us, data source: Ministry of Economy and Finance (MEF)**

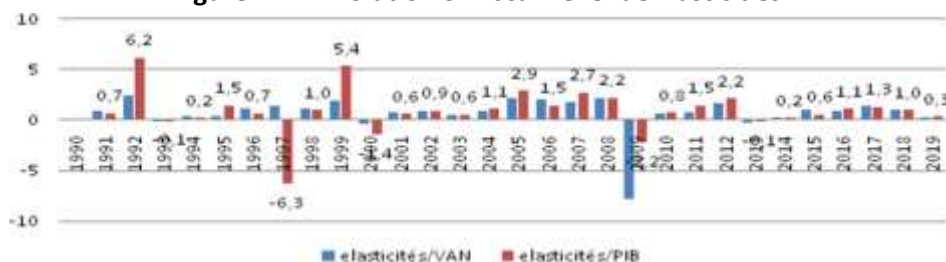
The analysis of the evolution of the tax burden in Morocco reveals a rising trend during the first and second decades, with this indicator increasing from an average annual value of 18% to 20%, before registering a slight stability during the third decade with an average of 20.6%.

**Taxation: Low Elasticity.**

Comparing the variations in tax revenues on one hand and those of GDP on the other hand, the fiscal elasticity coefficient expresses the system's ability to take advantage or not of economic growth, evolving in more or less significant proportions relative to the creation of wealth in the economy. Above 1, the coefficient indicates a faster evolution of tax resources than that of GDP, and below 1, the opposite situation is suggested.

During the studied period (1990-2019), this coefficient had significantly evolved, rising to 0.8 for the first decade (explaining the low evolution of tax revenues compared to that of GDP), before reaching an average value of 1.1 during the second decade. This coefficient reflects a stable relationship between the two indicators composing it (GDP and tax burden).

**Figure 1.12: Evolution of Fiscal Revenue Elasticities**



**Source: Graph created by us, data source: Ministry of Economy and Finance (MEF)**

However, it is evident that subsequently, this coefficient has experienced a deterioration during the last decade, falling below 1 (0.90). This indicates the necessity of a fiscal policy capable of maintaining stability between the two indicators.

The following table presents a summary of the arithmetic averages of the instantaneous elasticities of tax revenues, by main categories, relative to non-agricultural value added.

**Table 1.2: Instantaneous Elasticities of Tax Revenues Relative to Non-Agricultural Value Added**

Period	1990-2000	2001-2010	2011-2019
Direct Taxes	1,19	0,46	0,95
Corporate Tax	1,32	1,31	0,72
Income Tax	2,18	0,01	1,19
Other Direct Taxes	0,29	3,81	2,61
Customs Duties	0,4	-0,96	-0,19
Indirect Taxes	1,33	0,79	0,74
Value-Added Tax (VAT)	0,98	0,96	0,68
Excise Tax	2,22	0,8	0,95
Registration and Stamp Duty	0,92	0,66	1,18

**Source: Graph created by us, data source: Ministry of Economy and Finance (MEF)**

At the level of direct taxes, it is observed:

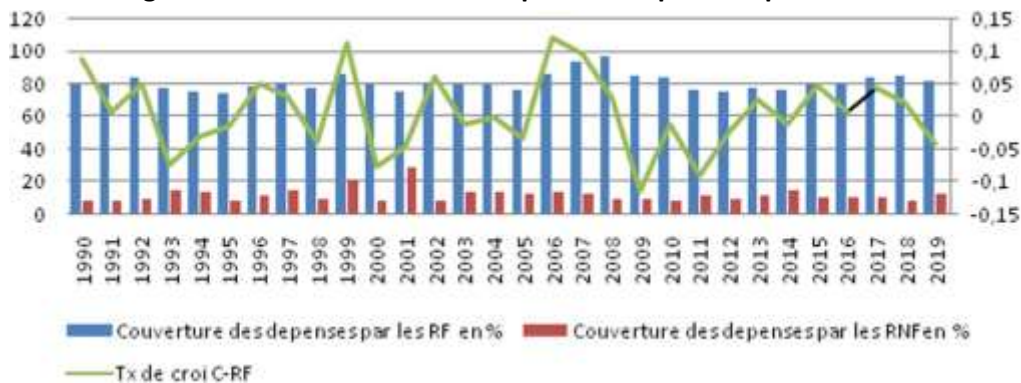
There has been a decrease in the elasticity coefficient over the three decades. This result can be attributed to the decrease in the elasticity coefficient of the income tax (IR), which decreased from 2.18 to 1.19, along with a remarkable drop in the corporate tax (IS) from 1.32 in the first decade to 0.72 in the third decade. As for indirect taxes, between 1990 and 2019, the average elasticity of indirect taxes stood at 0.96, decreasing from 1.81 in 1991 to 0.57 in 2019, with an average elasticity of 0.88 for VAT and 1.34 for other indirect taxes (TIC). This decline is attributed to decreases in both VAT and TIC elasticity, which were 1.29 and 3.12 respectively in 1991 before decreasing to 0.88 and 1.34 in 2019. Overall, these observations indicate a low elasticity.

Now, what about the coverage of state expenditures by tax revenues ?

**A low coverage of public expenditures**

Taxation represents a significant means to finance the state budget while ensuring substantial and sustainable resources to indirectly stimulate economic activity through the multipliers of public spending. As for debt, its limits have been dramatically highlighted in the past on several occasions, prompting any public finance recovery policy to set reducing its share in state budget financing among its precise objectives. The evolution of the share of tax revenues in funding state expenditures, in relation to other sources of financing, constitutes a primary objective to ensure that this share is in line with the potential of economic activity.

**Figure 1.13. Evolution of the components of public expenditures**



**Source : Graph created by us, data source : Ministry of Economy and Finance (MEF)**

Nevertheless, tax revenues remain the main source of financing for the general state budget. Indeed, tax revenues represent 88% of the general budget revenues during the studied period, while non-tax revenues cover only 12% during the same period. The evolution of the coverage rate of public expenditures by the two types of revenues, namely tax and non-tax revenues, shows an increasing trend for both categories during the first two decades. Their average annual values increased from 78% and 10% during the first decade (1990-2000) to 83% and 12% during the second decade (2000-2010). However, these two variables experienced a significant decrease during the third decade (2010-2019), with their values reaching 76% and 10%, respectively. This justifies the increased reliance on public borrowing to finance the state budget during this last decade.

## Chapter 2 : Literature Review: Theoretical and Empirical Perspectives

The theoretical debate on the role of taxation is not new ; it has long captured the interest of economists who have debated the role and relationship of tax revenues with economic activity, particularly the theoretical foundations of the classical, neoclassical, and Keynesian schools regarding state interventionism. However, for the purpose of our study, the focus lies on optimal taxation theory, which has been extensively developed by economists (Atkinson and Stiglitz, 1980; Auerbach, 1985; Ahmad and Stern, 1991; Myles, 1995). Optimal taxation seeks to find a tax system that minimizes the loss of collective welfare while respecting an exogenous budget constraint of the state. Optimal tax rates depend on agents' preferences and the forms of these budget constraints, but they do not directly depend on parameters that determine production. One application of this principle is the production efficiency principle, discovered by Diamond and Mirrlees (1971): if a tax does not directly influence households' budget constraints, its value should be chosen such that the transformation rates between the good corresponding to that tax and other goods are equal across all sectors.

For instance, in the case of perfect competition, constant returns to scale, and in the absence of external effects, the tax rates on intermediate goods should be zero. Lucas and Stokey (1983) demonstrate how the primal approach can be used to analyze optimal policy problems in a dynamic framework without capital. Subsequently, this approach was further developed in the works of Lucas (1990) and Chari and Kehoe (1991). Another theoretical development of optimal taxation theory concerns its relationship with economic growth, although the former is more concerned with analyzing households' preferences and budget constraints, and the latter with production and innovation. Ramsey (1928) introduced the theory of optimal saving. Koopmans (1965) and Cass (1965) incorporated optimal saving choice into the Solow growth model (1956), resulting in what is now called the neoclassical optimal growth model. This theory is well-explained in textbooks by Aghion and Howitt (1998), Blanchard and Fisher (1989), Barro and Sala-i-Martin (1996), Chiang (1992), Romer (2001), and Turnovsky (2000). It is still considered an interesting framework for analyzing the impact of fiscal policy on medium-term macroeconomic dynamics. Modern growth theory primarily focuses on production rather than household behavior. Therefore, its development does not significantly affect the main results of tax theory.

However, some contemporary works are quite important in the context of this research. Romer's article (1986) sparked a wave of research on endogenous growth theory. Rebelo (1991) discusses the roles of physical and human capital in Romer's AK models and generalizes the approach to  $Y = AK$ . Barro (1990) introduces public spending on infrastructure into an endogenous growth model. D'Auume and Michel (1993) show that compared to Arrow's analysis (1962), Romer (1986) made a good calibration choice, but did not construct a completely new production structure. A classic study in this direction is Barro's article (1974) on Ricardian equivalence, which demonstrates that the effect of public spending on the economy is entirely independent of how the spending is financed, particularly the choice between taxation (immediate payment) and borrowing (future payment). This theory relies on an intuition initially developed by David Ricardo and reformulated by Barro, suggesting that the propensity to consume has both a cyclical component and a stable component. The former obviously depends on current incomes, while the latter depends on the current perception of future incomes and, more

broadly, on the life cycle of incomes. It is therefore clearly a case of rational expectations. The modern application of this concept leads to the consideration that in the case of deficit-financed fiscal stimulus, economic agents will anticipate the probability of future tax increases and increase their savings to prepare for them, thereby diminishing the effects of the traditional Keynesian multiplier.

By substituting public debt for taxes, the government does not change the present value of future taxes and, consequently, the households' permanent income. Another theoretical argument for optimal taxation is the Laffer curve, which claims to demonstrate the existence of a ceiling on tax revenues. The disincentive effects on labor and savings from increasing tax rates would lead to a reduction in production volume. The increase in rates would eventually fail to compensate for the shrinking tax base, resulting in an absolute decrease in tax revenues. In other words, the higher the taxes rise, the more they undermine the market economy and, consequently, the tax system itself. A country's tax system destroys itself by surpassing a certain level of tax rates.

### **Fiscal Potential Analysis: A Literature Review**

In the literature related to fiscal potential, there are two main families of methods for constructing the efficiency frontier: parametric methods and non-parametric methods. In the parametric approach, it is assumed that the frontier can be represented by an analytical function dependent on a finite number of parameters. The problem consists of specifying this function and estimating its parameters, either through statistical methods of econometrics or methods derived from linear programming. In non-parametric methods, on the other hand, a specific analytical form for the frontier is not specified, but rather the formal properties that the production set is assumed to satisfy (Ambapour, 2001). The non-parametric approach stems from the initial work of Farrell and involves the use of linear programming techniques. The choice between the two approaches is not always easy. Bosman and Frecher (1992) recommend basing the choice on the knowledge of the technology of the sector under study.

### **Non-parametric measurement techniques**

Non-parametric methods construct the efficiency frontier directly from observations using linear programming techniques. They do not impose a priori form on the relationship between inputs and outputs; therefore, they do not allow for consideration of statistical error terms as opposed to parametric approach methods. The most popular non-parametric technique is Data Envelopment Analysis (DEA), which is particularly suited for measuring the relative efficiency of firms when multiple inputs are used to produce multiple outputs, and even more so when the production technique is uncertain or unknown. Therefore, it is particularly interesting in the case of banks or financial institutions. Its main drawback is that it is sensitive to measurement errors.

### **Parametric measurement techniques**

Parametric measurement methods specify the structural relationships between inputs and outputs, generally using a production function, a cost function, or a profit function. This function can be of types such as Cobb-Douglas, Translog, or Fourier, and the production possibilities frontier can take three forms: a stochastic frontier, a thick frontier, or a distribution-free frontier (Weill, 2004). They thus assume that the set of production possibilities can be represented by a particular function whose parameters are constant. The form of the technical relationship between inputs and outputs is imposed a priori, and the parameters of this function are estimated using econometrics (Weill, 2004). Parametric techniques consider a firm to be inefficient when costs are higher or when profits are lower than those generated by the most efficient firm in the market, after taking into account the error variable. The most well-known parametric methods include the stochastic frontier approach (SFA), distribution-free approach (DFA), and thick frontier approach (TFA).

### The stochastic frontier approach (SFA)

This approach is based on the cost or profit frontier of the production function that relates inputs, outputs, and other factors. It allows identifying an error variable  $\epsilon_{it}$  whose distribution is assumed to be different from that of the inefficiency term  $u_{it}$ ; it is also called an econometric frontier or a composite errors model. Indeed, unlike non-parametric methods, this method takes into account the presence of random errors. It is based on the following assumption: non-efficient observations follow an asymmetric distribution (usually a standard normal distribution). Thus, inefficient observations must have a truncated distribution since they cannot be negative. Another assumption is that inefficient observations, as well as errors, are orthogonal to inputs and outputs, meaning there is independence between these variables and the errors. Despite these assumptions, the distinction between random errors and inefficient observations remains quite challenging to determine. Two major approaches are used in the economic literature and are the most commonly employed to establish a production frontier and estimate technical efficiency: one is parametric, known as stochastic frontier analysis (SFA), and the other is non-parametric, based on mathematical programming and known as data envelopment analysis (DEA).

The main distinctive element of these two approaches lies in the assumptions regarding, on the one hand, the consideration of residuals (random factors), and on the other hand, the functional specification or non-specification of the production function. Thus, each of these two methods is based on a different conception of constructing this efficiency frontier. However, the SFA method decomposes the error term into two independent components. The first error term is assumed to follow a centered normal distribution, while the second follows a strictly positive normal distribution.

### The Empirical Studies

The literature on fiscal effort as a way to assess fiscal performance is vast. Despite the fact that the technique of panel data deals with the concept of averages while the stochastic frontier tax function deals with the concept of maximum, most studies have focused on the application of the stochastic frontier panel technique, confirming the robustness of these results. Lotz and Morss (1967) were the first to introduce the idea of fiscal effort using a cross-sectional dataset of 72 countries, namely GDP per capita and trade openness. They estimated international tax ratios for each country. Based on the results, both variables were found to be significant, but a breakdown of countries based on income revealed that they were significant only in the case of low-income countries. However, another study dating back to 1991, conducted by Leuthold, used panel data for the sub-Saharan Africa region to show that the share of trade relative to GDP had a positive impact on tax revenues, while the share of agriculture was negatively related to tax revenues.

Alfirman (2003) estimated the revenue potential of local authorities in the case of Indonesia using the stochastic frontier estimation method. The author shows that none of the local authorities have reached their revenue potential. He concludes that these administrations could increase their local revenues by 0.36% of GDP. The same approach was used by Davoodi and Grigorian (2007), who focused on factors explaining the low revenue ratio in the case of Armenia. These authors find that the persistence of the low revenue ratio in Armenia can be attributed to weak institutions. Furthermore, according to their results, the gap between the ratio of actually collected revenues and the potential level averages 6.4% of GDP over the period 1996-2006.

Langford and Ohlenburg (2015) quantified the fiscal potential for a panel of 85 resource-poor economies. Using stochastic frontier estimation, the study found that the estimated fiscal effort for 2009 varied from 38% in Guatemala to 90% in Sweden, with an average of 62% for all observations. Additionally, this study also showed that the tax potential in Morocco was 26.7%, representing a fiscal effort of 88% in 2010. The IMF (2015) estimated fiscal potential in a similar study for a group of 113 countries, including 23 countries in sub-Saharan Africa. It emerged from this work that the median sub-Saharan African country could potentially increase its tax revenues by an additional 3 to 6.5 percentage points. In their study, Bird et al. (2014) also attempted to estimate fiscal effort for developed countries. They showed that not only factors such as the relative share of the non-agricultural sector in the

economy or the weight of imports and exports in GDP are important, but also other parameters such as government efficiency, political stability, absence of violence, rule of law, and control of corruption positively affect the level of revenue collected.

For the case of ECOWAS countries, Ndiaye and Korsu (2011) used the stochastic frontier estimation method for aggregated public revenues such as direct taxes, indirect taxes, exports taxes, and all taxes combined. They found that the literacy rate has a positive effect on all categories of taxes considered, financial depth (M2/GDP) has a positive effect on indirect and export taxes, the agricultural share of GDP has a negative effect on direct and indirect taxes, and openness to imports and GDP per capita have positive effects on export taxes. Additionally, the authors showed that all ECOWAS countries are below their fiscal capacities. Gupta's study (2007) on 105 developing countries yielded similar results to those of Chambas and Brun (2010) regarding the sign of the agricultural sector's share and the import-to-GDP ratio. Furthermore, the author demonstrated that some structural factors such as GDP per capita and foreign aid have a positive effect on the ratio of public revenues. However, in most specifications, variables measuring political stability, corruption, and those describing fiscal policy have no impact on the ratio of taxes to GDP.

Furthermore, this study indicates that in several sub-Saharan African countries, the level of revenue collection exceeds the potential, unlike some Latin American countries where it falls below potential. Pessino and Fenochietto (2010) examined the determinants of fiscal effort for 96 developing countries, including Senegal. Using the stochastic frontier technique, this study corroborates Gupta's analysis (2007) on the sign of the trade openness rate, GDP per capita, and the share of the agricultural sector in GDP. However, in addition to these variables, the authors found a positive sign for public education spending as a percentage of GDP and a negative sign for inflation, the GINI coefficient on income distribution, and the corruption perception index. According to the results of this study, the tax pressure established at 16.1% in Senegal in 2001 could potentially range between 23% and 26.5%. Later, in 2013, these authors expanded their study from 96 to 113 countries and showed that in 2011, the tax rate of 19.4% could be increased to 26.8%, representing a fiscal effort of 7.4 percentage points for Senegal.

The same methodology was used by Ndiaye and Korsu (2011), who studied the determinants of tax revenues in ECOWAS countries and then constructed a fiscal effort indicator for these countries. The authors employed the stochastic frontier estimation method while considering disaggregated public revenues such as direct taxes, indirect taxes, export taxes, and all taxes combined. The results revealed that the literacy rate has a positive effect on all categories of taxes considered, financial depth (M2/GDP) has a positive effect on indirect taxation and taxation related to exports, the agricultural share of GDP has a negative effect on both direct and indirect taxes, and the openness of economies to imports and GDP per capita have positive effects on export taxes. Additionally, the authors demonstrated that all ECOWAS countries are below their fiscal capacities. In recent years, Langford and Ohlenburg (2015) quantified the fiscal potential for a panel of 85 economies with low natural resource endowments.

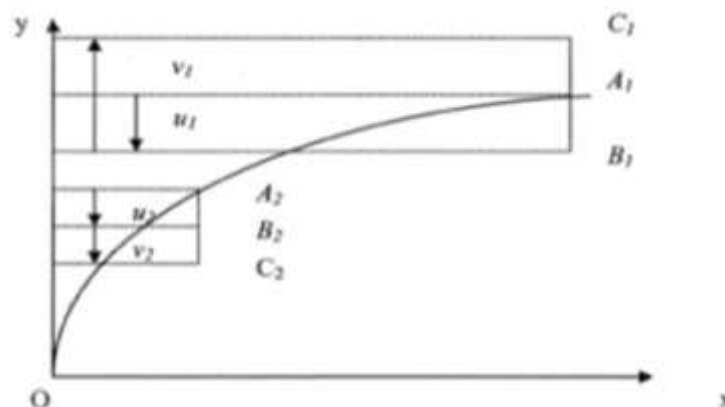
Using stochastic frontier estimation, the study found that the estimated fiscal effort for 2009 varied from 38% in Guatemala to 90% in Sweden, with an average of 62% for all observations. Additionally, this study also showed that Senegal's tax potential was 25.5%, resulting in a fiscal effort of 74% in 2010. The IMF (2015) estimated the fiscal potential in a similar study for a group of 113 countries, including 23 countries from sub-Saharan Africa. The findings suggest that sub-Saharan African countries could potentially increase their tax revenues by an additional 3 to 6.5 percentage points. Bird et al. (2014) also attempted to expand the simple model of fiscal effort by demonstrating that not only factors such as the relative share of the non-agricultural sector in the economy or the weight of imports and exports in GDP are important, but also other parameters such as government effectiveness, political stability, absence of violence, rule of law, and control of corruption have a positive impact on the level of revenue collected.

## Methodology

Fiscal effort assesses the effectiveness of all economic policy measures undertaken to mobilize tax revenues ; the reference situation corresponds to the adoption of international best practices. The resource component of revenues, i.e., the public revenues directly generated by natural resources (mining products), is excluded from the scope of the fiscal effort evaluation due to its exogenous nature to revenue mobilization policy.

The parametric stochastic approach finds its utility. Initially proposed by Aigner, Lovell, and Schmidt (1977) and Meeusen and Van Den Broek (1977), and improved by Jondrow et al. (1982), it allows for the estimation of specific technical efficiency scores for each firm (countries). The integration of these random effects is done by decomposing the error into two terms: an inefficiency component and a random error component combining measurement errors and exogenous shocks. The random component follows a symmetric normal distribution, while the inefficiency component follows a positively defined asymmetric distribution for a cost function and negatively for a production function. It thus allows estimating a frontier function that simultaneously takes into account the random error and a firm-specific inefficiency component. Figure 2 illustrates this characteristic. In this example, firm C1 shows an inefficiency  $u_1$  and a favorable exogenous shock  $v_1$ , greater than  $u_1$ , placing it beyond the efficiency frontier. On the other hand, the inefficiency  $u_2$  of firm C2 is worsened by an unfavorable exogenous shock  $v_2$ , situating it further below the efficient frontier, as in Guarda and Rouabah (1999).

**Figure 2.1: Graphical Representation of the Stochastic Production Frontier**



Source : Guarda et Rouabah (1999)

Therefore, the producer must make a trade-off for both firms so that its output lies within the efficiency curve in Zones A1 and A2, either by minimizing the output Y for firm C1 or by increasing the inputs X for firm C2.

The approach adopted in this study is inspired by the works of Aigner, Lovell, and Schmidt (1977), Battese and Coelli (1995), Kumbhakar and Lovell (2000), Kumbhakar et al. (2014), and Greene (2005), who have developed a methodology for stochastic frontier efficiency analysis. The reasoning of these authors is based on the assumption that production is suboptimal. They propose a more realistic view than that of neoclassical economics by considering the possibility that firms make errors in the production process. They specify a model in which production is affected by inefficiency associated with the mistakes made by the firm. For our case, production in the models we adopt is represented by tax revenues as a percentage of GDP. In comparison with a simple regression model, the SFA model differs in terms of estimating the error term. In a simple regression model, the error term fully represents inefficiency, which can be positive or negative. This indicates that a country may deviate from the estimated average tax revenues either downwards or upwards.

The frontier determines the maximum tax revenues that can be collected, given the level of structural factors for tax mobilization. This model allows for estimating the overall fiscal effort of a country based on best practices observed in the sample countries. However, the SFA model estimates a non-negative error term, ensuring that actual revenue cannot exceed the optimal maximum revenue (Pessino and Fenochietto, 2010; Cyan et al., 2013). Therefore, the use of the SFA model enables us to estimate the fiscal effort in Morocco and assess its evolution over time. Furthermore, Moroccan fiscal effort could be compared to estimates of fiscal effort from other countries in the panel with similar economic characteristics. In this study, we estimate fiscal effort using two SFA models: the inefficiency model by Battese and Coelli (1995) and the latest innovation, the model by Kumbhakar, Lien, and Hardker (2014).

This model allows for disaggregating the overall fiscal effort into a persistent fiscal effort due to economic policy decisions and a time-varying fiscal effort associated with the efficiency of the tax administration responsible for tax collection.

The stochastic fiscal frontier for the panel dataset could be defined as follows:

$$Y_{it} = \exp(\beta X_{it} + v_{it} - u_{it}) \quad (2.1)$$

Where  $Y_{it}$  is the tax-to-GDP ratio for the ( $i = 1, 2, \dots, N$ ) country at the  $t$  period ( $T = 1, 2, \dots, T$ ),  $X_{it}$  is the vector of input variables affecting the tax-to-GDP ratio,  $\beta$  is the vector of unknown parameters. The composite error term could be decomposed into two parts:  $v_{it}$  and  $u_{it}$ , where  $u_{it}$  is the inefficiency term which is non-negative. According to the model, this inefficiency is interpreted as a lack of fiscal effort.  $v_{it}$  is the statistical noise or random shock that takes a positive or negative value. Additionally,  $v_{it}$  follows a normal distribution with a mean  $\mu$  and variance  $\sigma^2$ . Both  $v_{it}$  and  $u_{it}$  are statistically independent. Jondrow, Knox Lovell, Materov, and Schmidt (1982) introduced the most commonly used method, by which the estimates of  $v_{it}$  and  $u_{it}$  can be separated from the estimated composite error; and, according to the literature, this study also uses the same method to separate fiscal inefficiency and statistical noise. According to the model, technical efficiency is the ratio of observed real production to potential production (Kumbhakar & Knox Lovell, 2000), and to adhere to this principle, fiscal effort is the ratio of observed real tax revenue to estimated tax capacity, and should fall between zero and one. This means that as a country's actual tax-to-GDP ratio approaches its tax capacity, fiscal effort approaches one. Thus, fiscal effort is given by :

$$\begin{aligned} \text{Tax effort} &= \frac{Y_{it}}{\exp(\beta X_{it} + v_{it})} \quad (2.2) \\ &= \frac{\exp(\beta X_{it} + v_{it} - u_{it})}{\exp(\beta X_{it} + v_{it})} \\ &= \exp(-u_{it}) \end{aligned}$$

The model by Battese and Coelli (1995) assumes that the fiscal inefficiency term is a function of explanatory variables beyond the government's control. This can be specified as follows:

$$u_{it} = \delta Z_{it} + W_{it} + v_{it} - \eta_i - u_{it} \quad (2.3)$$

Where  $Z_{it}$  represents the vector of exogenous variables and  $W_{it}$  is a random variable following a normal distribution with zero mean and variance 2. In contrast, the model by Kumbhakar, Lien, and Hardker (2014) considers two sub-components of  $u_{it}$  that separate the country effect from inefficiency. Therefore, under this model, the equation could be specified as follows:

$$\text{Tax}_{it} = \alpha + \beta X_{it} + \mu_i + (2.4)$$

As explained by Kumbhakar et al. (2014), this model consists of four sub-components of the error term.  $\mu_i$  is the country effect and  $\nu_{it}$  is the standard white noise. The last two components  $-\eta_i > 0$  and  $-\text{uit} > 0$  are inefficiency terms representing respectively a persistent country-specific inefficiency and a time-varying technical inefficiency. Kumbhakar et al. (2014) recommend using a three-step procedure to estimate the error term components using panel data.

The first step involves running a standard generalized least squares (GLS) model with random effects to estimate the country effects and the error term. In the second step, the time-varying inefficiency  $\text{uit}$  is predicted using the error term estimates obtained in the first step. They used the standard stochastic frontier technique for this purpose, and the prediction is calculated using the formula proposed by Jondrow et al. (1982). In the third step, the country-specific inefficiency  $-\eta_i$  is estimated using the same stochastic frontier model as in the second step and using the estimated country effects from the first step. Finally, the overall technical efficiency (TE) is calculated as:

ET global = Time-varying efficiency  $\times$  Persistent efficiency  
 ET = Technical Efficiency (in our case, it represents fiscal effort)

## Variables and Data

### Variable Selection

Estimating a fiscal potential equation requires mobilizing certain structural factors that can define the level of tax revenues a country can collect. The goal is to predict the maximum level of tax revenues that the country can generate, taking into account its specificities.

In this sense, it is different from fiscal performance, which is linked to its capacity to collect taxes. Thus, fiscal performance can be influenced by political decisions when adopting tax laws and the quality of institutions (quality of bureaucracy, corruption) overseeing tax collection.

Therefore, by improving its performance, a country can reach its fiscal potential or tax capacity. The dependent variable in our analysis is public tax revenues as a percentage of GDP, drawn from the dataset on public revenues from December 2019 published by the International Centre for Tax and Development (ICTD). The tax-to-GDP ratio includes all tax revenues collected by the government through different types of taxes but excludes revenues derived from resources and social contributions.

To remain consistent with the literature on fiscal potential, the evaluation of both fiscal potential and fiscal effort in this study relies solely on structural variables, namely the logarithm of GDP per capita. A high national income implies a broad tax base. Moreover, the demand for public goods increases with the level of development (Wagner's law), particularly due to social insurance requirements (Rodrik, 1999). The coefficient sign of GDP per capita should thus be positive. The composition of output is represented by the share of agriculture in GDP, and trade openness is represented by the shares of imports and exports. Other economic variables include inflation, the external debt stock as a percentage of gross national income, and domestic credit provided by the financial sector. Additionally, we include three other non-economic variables: age dependency, the Gini coefficient, and the level of education. It is important to note that the level of education can be considered as a widely used explanatory variable to assess tax capacity, assuming a positive relationship between these two variables. The last variable used in this study is the share of the informal sector as a percentage of GDP, sourced from the estimation by Medina and Schneider (2018), and it has been used as an exogenous variable in the model of Battese and Coelli (1995) to explain inefficiency. Table 3.3 in the annex presents the descriptive statistics of all explanatory variables.

## Chapter 3 : Results

Firstly, to justify the validity of using the SFA model, a normality test was conducted by examining whether the residuals from ordinary least squares (OLS) estimation exhibit a negative bias. As shown in Figure 3.2 in the appendices, the skewness of the error term is -0.02, which is consistent with the specification of the SFA model.

### Results of the stochastic frontier estimation using the BC(95) model:

Next, as indicated in the previous section, we used the Battese and Coelli (1995) model to estimate the fiscal effort of the group of middle-income countries, including Morocco. The first part of Table 3.1 (below) shows the results of the stochastic frontier estimation related to this model, and the second part corresponds to the inefficiency, where the latter is determined based on the share of the informal sector in the economy. According to the results of this estimation, the majority of the coefficients of the variables are significant. The sign of the variable GDP per capita is positive and significant, justifying the fact that higher income levels generate higher tax revenues. Considering the argument that the fiscal share level could affect GDP, the share of agriculture in GDP has a negative relationship with tax revenues with a significant level of 1%. This is particularly evident in developing countries due to their subsistence nature and low productivity in their agricultural sectors. However, the share of exports in GDP has a positive and significant relationship with tax revenues, as it is a well-organized sector and also contributes to the economy's enrichment as an element of overall demand. On the other hand, the share of imports in GDP has a negative relationship with tax revenues, aligning with a large part of the economic literature advocating for the use of local products to boost economic activity and employment. The level of development of the financial sector, represented by the share of domestic credit provided by the financial sector as a percentage of GDP, is also an important determinant of tax revenues.

The coefficient associated with this variable has a positive relationship with the independent variable, indicating that the development of the financial sector is essential for increasing tax revenues in developing countries, as it enables the recording of financial transactions through financial systems where the information collected could be used for tax purposes. Another variable with a negative relationship with the independent variable is external debt as a percentage of GDP. This means that increasing debt weakens tax revenues due to its negative role in economic activity. The level of education is a significant determinant and has a negative relationship with tax revenues, which is not consistent with previous tax literature, which argues that a well-educated society may better understand the importance of paying taxes for the provision of public goods. Income inequality represented by the GINI index is not a determinant factor of tax revenues, but the age dependency variable is negatively associated with tax revenues. The informal sector as a variable explaining the inefficiency term is positive, indicating that a larger informal sector makes the tax system less efficient, which is characteristic of developing countries.

Then, this fiscal efficiency was calculated according to the formula presented by Jondrow et al. (1982).

**Table 3.1: Stochastic tax frontier model :BC(95)**

Variables	Coefficients	SE	Pvalue
Variable indépendante (logtaxgdp)			
Frontier			
Logedu	-0.2336189***	0.064098	0.000
Loggdp	0.1720683***	0.0319478	0.000
Logagri	-0.2590573***	0.0296005	0.000
Logimp	-0.0539459**	0.0281927	0.056
Logexp	0.4062915***	0.0325504	0.000
Logdebt	-0.1652096***	0.0334621	0.000
Logcredit	0.0255809**	0.0101424	0.012
Logage	-0.0730731*	0.0296978	0.014
Loggini	0.0243622	0.0294228	0.408
infla	-0.0002659	0.0002482	0.284
cons	2.714618***	0.3328241	0.000
Mu			
Logshad	0.0914448***	0.0335557	0.006
cons	0.9859308	.	.
Usigma			
cons	-3.121939	0.603562	0.681
Vsigma			
cons	-3.120877	0.595487	0.681

Source: Estimation performed using Stata software, author's calculation.

\*p < 0.1, \*\*p < 0.05, \*\*\*p < 0.01

**Results of stochastic frontier estimation by the Kumbhakar, Lien, and Hardaker (2014) model**

As indicated in the methodology section, the fiscal effort in this model is predicted following a three-step procedure. The first step involves the standard estimation of random effects. After presenting the results of this estimation in Table 3.1, we will directly comment on the results of the second step.

**Table 3.2: Stochastic tax frontier model :KH(2014)**

	Time-varying inefficiency (half-normal)	Persistent inefficiency (halfnormal)
Variable Dépendent	$u_{it}$	$\eta_i$
Constant	0.299*** (-0.017)	0.153*** (5.10E-06)
Usigma		
Constant	-1.941*** (-0.11)	-3.544*** (0.047)
Vsigma		
Constant	-3.346*** (0.122)	-79.65*** (0.134)
N	883	883
Log likelihood	-159.56395	923.915

Source: Estimation performed using Stata software, author's calculation.  
 \*p < 0.1, \*\*p < 0.05, \*\*\*p < 0.01

The table (3.2) presents the results of estimating fiscal inefficiency using SFA models. The first column displays the estimated results of time-varying fiscal inefficiency, while the second column shows the results of country-specific fiscal inefficiency. The results indicate that all terms of inefficiency, whether time-varying or persistence-related, are significant and reflect the importance of this error term. These findings are consistent with the conclusions of the study by Brun and Diakite (2015) on Sub-Saharan African countries, which suggests that fiscal gaps in these countries depend more on policy decisions (laws, tax reforms) than on the performance of tax administration agents.

The variation in total error term due to time-varying inefficiency is relatively high compared to that due to persistence. As in the previous model, we used the formula by Jondrow et al. (1982) to predict both time-varying efficiency and country-specific efficiency values. Finally, we calculated the overall fiscal efficiency by multiplying these two subcomponents.

**Table 3.3: Distribution of the Weight of Model-related Inefficiency: KH(2014)**

	Obs	Mean	Std. Dev	Min	Max
L'efficience variable ( $TE_{Rk}lh$ )	883	0.764	0.119	0.335	0.952
L'efficience persistente ( $TE_{Pk}lh$ )	883	0.86	0.064	0.779	1
L'efficience globale ( $OTE_klh$ )	883	0.3288	0.0575	0.1413	0.4606

Source : Estimation performed using Stata software, author's calculation.

This table presents the distribution of the weight of technical inefficiency components derived from the estimation. These correspond to the nature of inefficiency in the total composition of the error term. For example, variable efficiency ( $TE_{Rk}lh$ ) corresponds to the fiscal gap more dependent on policy decisions (laws, tax reform), while persistent fiscal efficiency ( $TE_{Pk}lh$ ) corresponds more to the fiscal gap dependent on the performance of tax administration agents. The results of the table above show that inefficiency related to fiscal policy decisions is more significant than that related to the management mode of tax administration. Given that our main concern is to examine fiscal effort in Morocco, we dedicate the following section to discussing the estimations of fiscal effort in Morocco.

### Estimation of Fiscal Effort in Morocco using SFA Models

According to the results presented in the table below, the evolution of Moroccan fiscal effort during the studied period shows that there is not a significant difference between the two methods used to estimate Moroccan fiscal effort. It remains around 30%, indicating that the efforts deployed, whether through fiscal policies or tax administration management, are still underutilized.

Based on the figures generated by the Kumbhakar, Lien, and Hardaker (2014) model, both components, whether residual or persistence-related, respectively average around 0.90 and 0.86 during the studied period. This suggests that Moroccan fiscal policy implementation and tax collection methods remain far from best practices. The gap in fiscal effort, which had relatively decreased over the past four years (2016, 2017, 2018, and 2019), has contributed to the improvement in GDP during the same period (see Graph 100). The recent decrease in tax revenues can be attributed to the decline in structural fiscal capacity, which decreased from 25% of GDP in 2008 to 20.6% of GDP in 2019. This decline may be explained by the underutilized fiscal effort during this period. Despite the reforms implemented to improve tax revenues, the effectiveness of fiscal mobilization policy in Morocco remained stable, preventing a stronger convergence of actual tax revenues towards a growing structural potential.

**Table 3.4: Estimation of Fiscal Effort in Morocco using SFA Models**

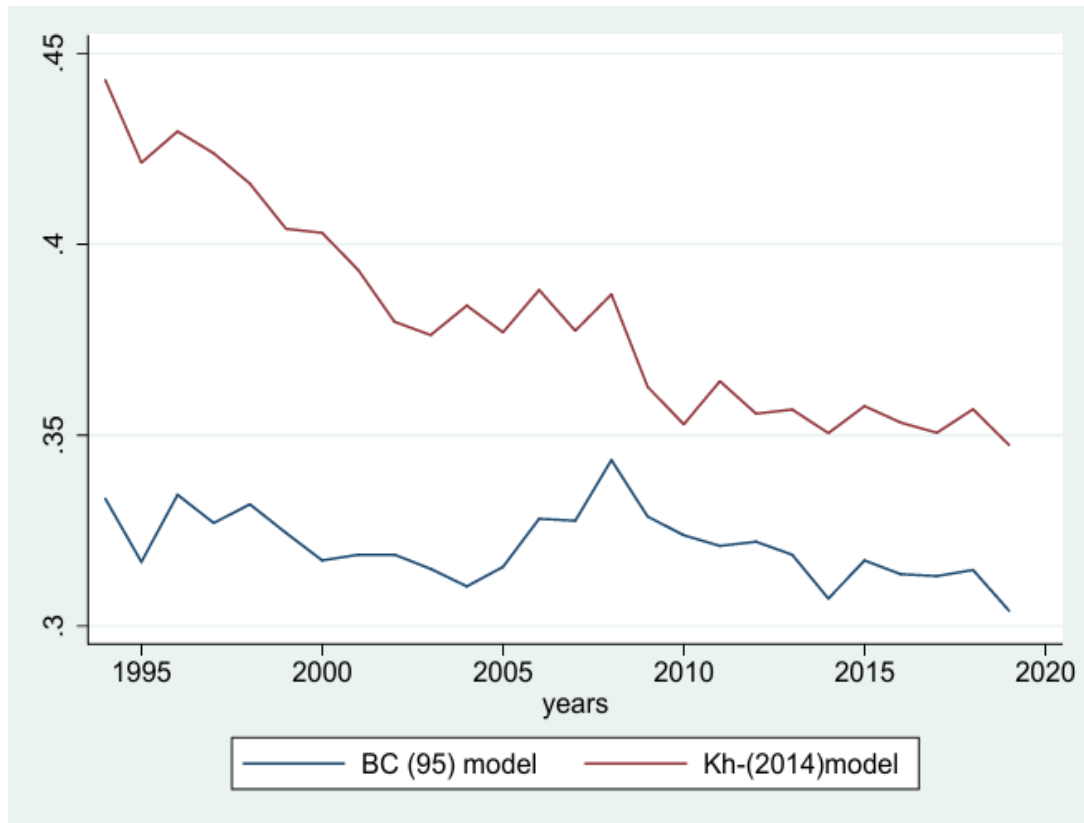
Années cline3-5	BC (95) model	Kumbhakar, Lien & Hardaker (2014)model		
		Residual	Persistent	Total
1994	0.3334	0.8861	0.904	0.4430
1995	0.3168	0.8679	0.971	0.4214
1996	0.3344	0.8927	0.9624	0.4296
1997	0.327	0.8821	0.9609	0.4238
1998	0.3319	0.8955	0.9289	0.4159
1999	0.3244	0.8869	0.9112	0.4041
2000	0.3172	0.8723	0.924	0.4030
2001	0.3187	0.8788	0.8949	0.3932
2002	0.3187	0.8919	0.8515	0.3797
2003	0.315	0.8839	0.8512	0.3762
2004	0.3104	0.8627	0.8901	0.3839
2005	0.3155	0.8786	0.858	0.3769
2006	0.3281	0.8951	0.867	0.3880
2007	0.3276	0.8963	0.842	0.3774
2008	0.3435	0.9116	0.8488	0.3869
2009	0.3287	0.9061	0.8005	0.3627
2010	0.3238	0.9047	0.78	0.3528
2011	0.321	0.8909	0.8175	0.3641
2012	0.3221	0.9	0.7903	0.3556
2013	0.3187	0.895	0.7972	0.3567
2014	0.3072	0.8726	0.8034	0.3505
2015	0.3172	0.8898	0.8038	0.3576
2016	0.3136	0.8853	0.7982	0.3533
2017	0.3131	0.8845	0.7928	0.3506
2018	0.3147	0.8843	0.807	0.3568
2019	0.304	0.8591	0.8087	0.3474

Source : Estimation performed using Stata software, author's calculation.

### Conclusion

The present study has allowed for the evaluation of the fiscal potential in Morocco. The evolution of the tax burden in Morocco reveals an increasing trend during the first and second decades, rising from an average annual value of 18% to 20% before stabilizing slightly during the third decade at an average of 20.6%. In 2008, this indicator peaked at 25% before decreasing to 20% in 2019. However, the weight of the taxes composing the tax revenues shows a different evolution over time, notably influenced by fiscal measures and efforts made by the administration.

Figure 3.1: Estimation of Fiscal Effort in Morocco using SFA Models



**Source: Estimation performed using Stata software, author's calculation.**

The stochastic frontier efficiency models approach has been adopted, considering the latest theoretical and empirical advancements in this field. The results also indicate that there is sufficient fiscal space to be tapped into to meet the growing needs of Morocco in terms of development expenditures. Consequently, the Moroccan government should make efforts related to revenue collection by modernizing procedures and means to facilitate tax collection. Efforts should also be directed towards designing effective tax policies to fully exploit this fiscal maneuvering room.

However, measures aimed at improving fiscal effort should be implemented with a greater focus on integrating the informal sector and combating exemptions granted by the state, particularly to agricultural activities, and phenomena of tax evasion. Although the integration of these sectors is challenging, estimates made during the latest fiscal conferences in 2019 indicate that less than 1% of companies alone finance 80% of corporate tax, and 73% of income tax is borne solely by employees. This necessitates further studies to quantify the efficiency of each tax category (VAT, corporate tax, income tax, etc.) and to analyze the impact of changes (increases or decreases) in these taxes on the Moroccan economy.

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